REMARKS

The present Response does not amend, add, or cancel any claims. Accordingly, claims 1-10 remain pending in the application. Claims 1, 3, 5, 7, and 10 are independent.

Applicants would like to thank Examiners Brutus and Le for the courtesy and cooperation extended during the interview conducted on March 3, 2009. During the interview, Applicants discussed the features of the invention as recited in the independent claims. In particular, Applicants indicated that the claimed invention uses Legendre polynomial coefficients to measure the velocity. In contrast, the cited reference did not measure velocity using Legendre polynomials. Trigonometric equations using the arctangent were applied to calculate the velocity. Legendre polynomials were only used to remove clutter.

In the Office Action of December 23, 2008, claims 1-10 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,228,009 issued to Forestieri et al ("Forestieri") in view of U.S. Patent 5,570,691 issued to Wright et al ("Wright"), and/or U.S. Patent 5,622,174 issued to Yamazaki et al ("Yamazaki"). This rejection is respectfully traversed.

In rejecting the claims, the Office Action alleges that Forestieri discloses a signal processing apparatus and method to eliminate undesirable clutter signals which includes a transmitter/receiver, color flow processor, Doppler processor, scan converter, control unit, video processor, wall filters, A/D converter, and velocity estimator. The Office Action further indicates that the transmitter/receiver circuitry is typically known as a beam former capable of measuring an imaging blood flow in the human body using Doppler principle wherein a transmitted burst of ultrasound

provided at a specific frequency is reflected from moving blood cells. The Office Action further indicates that Forestieri discloses a Doppler processor which produces a continuous time series of spectral Doppler information in which blood flow velocities are displayed in black and white on a video display over one or more cycles. In particular, the Office Action alleges that Forestieri discloses the use of multiple Legendre polynomials where an expansion coefficient of an even-numbered degree term and an expansion of an odd-numbered degree term which is different by one degree and starting from zero can be provided. The Office Action also indicates that Forestieri discloses the use of an imaginary unit as a coefficient and complex coefficients, and fitting linear drift of each waveform with sinusoids that have integer numbers of full cycles.

The Office Action admits that Forestieri fails to disclose a transmission beam former and a reception beam former, as well as a ratio between the magnitudes of each complex expansion coefficient. Wright is relied upon for disclosing an ultrasound Doppler imaging and transmit beam former and receive beam former. Yamazaki is relied upon for teaching the features of displaying the magnitude of the velocity, and superimposing color velocity images on a display. Applicants respectfully disagree.

Independent claim 1 defines a Doppler velocity detection device for transmitting/receiving pulse waves to/from an object whose velocity is to be measured a plurality of times, and analyzing the velocity of the object based on received echo signals. According to independent claim 1, reception echo time-series signals obtained by arranging reception echo signals of equal lapse time from transmission times of pulses in order of the transmission times are expanded as

components of a Legendre polynomial. Furthermore, a velocity signal of the object is obtained based on the magnitudes of the expansion coefficients. According to such a feature, it is possible to accurately detect the velocity of moving reflectors, such as blood flow in the body. Furthermore, it is possible to eliminate the influence of clutter echo signals having amplitudes that are significantly larger than that of an echo signal.

The Office Action alleges that the combination of cited references discloses all the features of the claimed invention. Applicants' review of these references, however, suggests otherwise. Forestieri discloses a signal processing apparatus for eliminating clutter signals from desirable signals. Orthonormal basis functions are subtracted from signal samples in order to remove the clutter, thereby eliminating the need for filters. According to Forestieri, the Legendre series is used only to remove clutter. Next, a frequency estimation is performed using an arctangent operation in order to determine the velocity. Thus, Forestieri never uses the Legendre series to determine velocity. It is only used for elimination of clutter.

As discussed during the interview, when the velocity of a moving object is determined and analyzed using equations that incorporate phase rotations, problems occur in latter stages of the process where a polynomial regression filter is applied. Specifically, a velocity computation error occurring around the cutoff frequency becomes significantly larger than that of a conventional filter. Consequently, the signal of a moving object in a frequency band of a portion extending to a low band cannot be used due to the sharp cutoff characteristic of the polynomial regression filter.

As can be appreciated, equation (1) of the instant Disclosure is similar to the equation applied at step 613 in Forestieri wherein $\Delta\Phi$ correspond to the arctangent in Forestieri. Thus, detection and analysis of the velocity is performed using the equation after the polynomial regression filter (i.e., Legendre series) has been applied. Furthermore, as illustrated in Fig. 23, a velocity detection result that utilizes trigonometric function after application of the polynomial regression filter result in greater computational errors around the cutoff frequency where the velocity is smaller. In contrast, such errors do not occur when measuring the velocity using the Legendre polynomials, according to the present invention. See Fig. 25. The cited references simply fail to provide any disclosure or suggestion for the use of Legendre polynomials to detect velocity, as set forth in independent claim 1.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claim 2 depends from independent claim 1, and is therefore believed allowable for at least the reasons set forth above with respect to independent claim 1. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

Independent claim 3 defines a Doppler velocity detection device that includes, in part:

> wherein the velocity analyzing means obtains a complex expansion coefficient by linearly connecting an expansion coefficient of an even-numbered degree term and an expansion coefficient of an odd-numbered degree term which is different from the even-numbered degree term by one degree, derived when reception echo time-series signals obtained by arranging reception echo signals of equal lapse time from pulse transmission times in order of the transmission times are expanded as components of a Legendre polynomial starting from the 0th degree, by using an imaginary unit as a coefficient, and obtains a signed velocity signal of a moving reflector in the subject on the basis

of the ratio between the magnitude of each complex expansion coefficient and the magnitude of an interval between the complex expansion coefficients.

According to at least one feature of independent claim 3, the Legendre polynomial is used to obtain a velocity signal. As previously discussed with respect to independent claim 1, such features are not shown or suggested by the art of record.

It is therefore respectfully submitted that independent claim 3 is allowable over the art of record.

Claim 4 depends from independent claim 3, and is therefore believed allowable for at least the reasons set forth above with respect to independent claim 3. In addition, this claim introduces novel elements that independently render it patentable over the art of record.

Independent claims 5, 7, and 10 each recite ultrasonographic devices which utilizes Legendre polynomials to determine velocity. As previously discussed, the cited references fail to provide any disclosure or suggestion for such features. Rather, Forestieri utilizes polynomial expansion only to remove clutter. An arctangent calculation is used to determine the velocity.

It is therefore respectfully submitted that independent claims 5, 7, and 10 are allowable over the art of record.

Claim 6 depends from independent claim 5, and claims 8 and 9 depend from independent claim 7. Accordingly, these claims are believed to be allowable for at least the reasons set forth above with respect to independent claims 5 and 7.

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 520.46163X00).

Respectfully submitted,

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Dated: May 26, 2009